SECTION 3
ARCHITECTURAL COATINGS MARKET ANALYSIS

In this section, market effects of the regulatory action are analyzed by presenting a model of how the outcome of the reformulate/fee/withdrawal decision collectively affects aggregate supply conditions and market outcomes in the architectural coatings industry. Then, operationalizing the model using baseline market data and regulatory costs is discussed to analyze the social cost effects of these market outcomes in the architectural coatings industry. The section ends with an analysis of employment impacts.

3.1 MARKET EFFECTS OF FIRM RESPONSES TO REGULATION

Firms' decisions to either reformulate or pay the exceedance fee and remain in the market or to do neither and exit the market collectively affect market outcomes (price, quantity, and welfare). The change in market price depends on the aggregate effects of the supply responses of the individual producers. Product exits will shift the aggregate supply function inward, and marginal cost effects, such as the per-unit fee, will shift the function upward. This change can be expected to raise the post-regulatory market price as the new equilibrium is attained. This process is described in more detail in Appendix D.

Appendix D describes the methodology for incorporating the reformulation/fee/withdrawal effects into a linked multiple-market model framework. This appendix also presents the methodology for measuring the social welfare effects (e.g., producer and consumer surplus) of the changes in market equilibrium, which is affected by the regulation.

3.1.1 Model Execution and Results

To estimate the effect of VOC content limits on architectural coatings markets, a baseline characterization of affected markets was constructed, empirically estimated shifts in market supply and demand as a result of the regulations were computed, and the market equilibrium model was applied to the data to generate changes in prices and quantities in each market.

3.1.1.1 Baseline. The coatings categories are grouped into market segments, as defined in Table 2-3. The price and quantity data necessary to analyze market effects are not provided in the survey conducted for this study but are available from the U.S. Census Bureau Current Industrial Reports publications.[61] Because the Census Bureau categorizes architectural coatings products differently than they are classified in the survey for this study, the market segments were constructed so that data can be used from both sources and provide the necessary level of resolution for market analysis. This process resulted in the 13 market segments presented in Table 2-3. Appendix A provides the details of this product/market cross-referencing scheme.

Table 2-3 lists quantities and value of shipments for each market segment. From these data, the average price for each market was imputed. Because the market segment price is an average value, it may obscure heterogeneity of products within each group. Although the model aggregates different products together to construct individual market segments, the objective in aggregating to the market segments in Table 2-3

is to provide a level of resolution that both highlights differences in the end use of the product (e.g., exterior coatings versus interior coatings) and distinguishes between groups that will be affected differently by the VOC content regulation (e.g., solventborne versus waterborne). Eight of the 13 segments consist of four pairs of related product groups; one in each pair represents solventborne products and the other represents waterborne products (e.g., interior coatings). Although the products in each of the paired market segments possess different attributes, they perform similar functions, thereby suggesting a high degree of product substitutability in demand. Demand elasticities were estimated using procedures outlined in Appendix A. Supply elasticities could not be econometrically estimated because of data limitations; therefore, the aggregate supply elasticity for each market segment was assumed to be unitary (1.0).

3.1.1.2 Quantifying Market Shocks. The best-response regulatory strategy for each stratum in the survey exceeding the TOS limits is computed in the previous section. For the market analysis, the least-cost solution obtained previously was compared to an estimate of per-unit profits. If the cost term exceeded the profit term, that stratum was identified as a "withdrawal" stratum. Throughout this section, the market results using upper bound of product reformulation cost ($14,573 per year) are presented unless otherwise indicated. If the profit term exceeded the cost term and the least-cost option was reformulation, the stratum was identified as a "reformulation" stratum. If the profit term exceeded the cost term and the least-cost option was the fee, the stratum was identified as a "fee" stratum. The model computes the total quantity share of the withdrawal strata by summing the total quantity from these strata (Q_S^X) and dividing by the total baseline quantity from all strata for that market segment in the survey (Q_S^T). This share was then multiplied by two-thirds

(the previously referenced share of all noncompliant formulas needing reformulation) to compute the market quantity subject to the withdrawal option, which is denoted as the term R^X.[a]

$$R^X = (Q_S^X/Q_S^T) \bullet (2/3). \quad (3.1)$$

Similarly, the model computes the total quantity shares for the reformulation R superscript) and the fee strata (F superscript), respectively:

$$R^R = (Q_S^R/Q_S^T) \bullet (2/3) \quad (3.2)$$

$$R^F = (Q_S^F/Q_S^T) \bullet (2/3). \quad (3.3)$$

Finally, all quantities not allocated to the exit, reformulation, or fee actions can be viewed as the unconstrained share:

$$R^U = 1 - R^X - R^R - R^F. \quad (3.4)$$

To perform the market and welfare effects calculations, the initial baseline market-level values for the exiting, reformulating, fee-paying, and unconstrained sectors are obtained for reasons explained in the methodology description in Appendix D. The model derives baseline quantities by multiplying the quantity shares derived from the survey data by the initial baseline market quantity, Q_0:

$$Q^X = R^X \bullet Q_0 \quad (3.5)$$

$$Q^R = R^R \bullet Q_0 \quad (3.6)$$

[a]Multiplication by two-thirds incorporates the previously discussed assumption that one-third of all products exceeding the limit can be costlessly reformulated (and thus would not be withdrawn).

$$Q^F = R^F \bullet Q_0 \quad (3.7)$$

$$Q^U = R^U \bullet Q_0. \quad (3.8)$$

To quantify the supply effects of the per-unit fee on the fee-paying sector, as indicated in the equilibrium model discussion in Appendix D, the model computes a value for the unit fee as follows.

$$F = \sum_{i=1}^{N^F} F_i \bullet (Q_{Si}{}^F / Q_S{}^F) \quad (3.9)$$

where F_i is the fee for fee-paying stratum i, $Q_{Si}{}^F$ is stratum i's quantity, and N is the number of fee strata in the market.

Finally, note that the measure of producer surplus losses requires an estimate of marketwide reformulation costs. The model estimates this cost by taking the estimated number of (surveyed and nonsurveyed) products in each market opting to reformulate and multiplying this number by the annualized cost of reformulation.

Changes in Output and Price. Table 3-1 reports the estimated output and price effects of the final regulation. In general, the annual output and price effects are quite small relative to baseline values. Price increases are typically well below 1 percent of baseline price, with the exception of the solventborne primers and undercoaters market segment, where the projected price increase is $0.012/L (0.4 percent). In fact, to show any price effect, the change in price is displayed to the fourth significant digit. In

TABLE 3-1. REGULATORY EFFECTS ON ARCHITECTURAL COATINGS MARKET OUTPUT AND PRICES

No.	Market Segment	Change in Output Produced (10^3 L)	% Change from Baseline	Change in Price ($1991)	% Change from Baseline	New Quantity (10^3 L)	New Price ($/L)
1	Exterior & high performance—solventborne	-195	-0.12%	$0.0029	0.09%	162,741	$3.32
2	Exterior & high performance—waterborne	69	0.01%	$0.0003	0.02%	468,414	$2.24
3	Interior solventborne	-36	-0.04%	$0.0010	0.03%	94,900	$3.19
4	Interior waterborne	22	0.00%	$0.0001	0.01%	833,456	$2.10
5	Solventborne primers and undercoaters	-349	-0.57%	$0.0120	0.43%	60,950	$2.81
6	Waterborne primers and undercoaters	52	0.07%	$0.0015	0.07%	75,264	$2.14
7	Solventborne clear coating, sealers, stains	-172	-0.13%	$0.0029	0.10%	134,506	$3.07
8	Waterborne clear coatings and stains	19	0.02%	$0.0004	0.02%	120,757	$2.21
9	Architectural lacquers	0	0.00%	$0.0000	0.00%	40,011	$2.08
10	Wood preservatives	-2	-0.01%	$0.0003	0.02%	27,446	$1.45
11	Traffic marking paints	-42	-0.05%	$0.0013	0.09%	91,025	$1.46
12	Special purpose	-15	-0.04%	$0.0035	0.08%	34,554	$4.10
13	Industrial maintenance	-277	-0.12%	$0.0083	0.24%	230,984	$3.46
	Total	-926	-0.04%			2,375,006	

other words, the average market price for nearly all 13 market segments changes by less than 1 cent per unit. Estimated quantity reductions, across all architectural coatings markets are approximately 926,000 L/yr. This figure is less than one-tenth of a percent of the industry baseline quantity.

The results indicate differential impacts across market segments. For example, solventborne primers and Industrial Maintenance show the largest reduction in output. However, four of the waterborne market segments show a net increase in output produced. These projected increases result as consumers substitute away from the solventborne counterparts because of the regulation-induced supply contraction and price increases in those segments. While noteworthy, these increases are quite small in absolute terms.

Total Social Costs. The method for estimating changes in consumer and producer welfare effects is demonstrated in Appendix D. In general, the net welfare effect (social cost) of the regulation equals the sum of consumer surplus, producer surplus, and government surplus measures. Costs are distributed across parties in such a way that reformulating, fee-paying, and exiting producers experience welfare losses by incurring the regulatory costs (or withdrawing products) and consumers bear welfare costs through higher prices. Changes in consumer surplus measure losses to consumers from higher prices and foregone consumption. The total change in producer surplus for each scenario equals the sum of the change in producer surplus for the exiting products, fee-paying products, reformulating products, and unconstrained products. Losses to exiting products reflect the foregone profits the producers would have received had the products stayed in the market. Losses for fee-paying products measure the net effect of fee payments and recordkeeping costs plus the partial offset of these losses by the rise in price caused by the regulation.

In Table 3-2, the producer losses for reformulating producers total -$20.4 million. The model actually projects total reformulation costs of $19.0 million, but $0.8 million of total reformulation costs are recovered from offsetting price gains accruing to the reformulating producers.

Note that the producer surplus effect for unconstrained products is positive, reflecting the fact that producers of these products gain the benefits of the regulation-induced rise in price, without any change in their cost structure caused by the regulation. However, the welfare gains accruing to the unconstrained products are transfers from coating consumers and, as such, should not be viewed as a net welfare gain to society due to the regulation.

The net annual welfare cost estimate is $22.3 million. This is approximately $12 million (41 percent) less than the initial cost estimate for the regulation under the reformulation-only scenario (Table 2-2). Therefore, accounting for economic responses substantially reduces the estimate of regulatory costs. Welfare gains accrue to unconstrained producers through higher prices ($3.2 million) and the recipient of exceedance fee revenues ($4.0 million), identified here as the government sector.[b] However, the government may redistribute these revenues back to any of the parties affected directly by the regulations or back to the citizenry via the Federal Treasury. From society's perspective, the net welfare effects of the current transfer method (architectural producers to the government) or alternative

[b]Note that the difference in losses to fee-paying producers ($4.9 million) and government receipts ($4.7 million) is due to two factors: the payment of fee-related recordkeeping costs (+$0.6 million) and gains from offsetting price increases (-$0.4 million).

TABLE 3-2. ARCHITECTURAL COATINGS MARKET WELFARE EFFECTS

No.	Market Segment	Change in Producer Surplus ($1991)					Change in Consumer Surplus ($1991 10^3)	Change in Government Surplus ($1991 10^3)	Net Welfare Effects ($1991 10^3)
		Exiting Products (10^3)	Fee-Paying Products (10^3)	Reformulating Producers[a] (10^3)	Unconstrained (Net) Total PS Sector (10^3)	Total (10^3)			
1	Exterior & high performance—solventborne	-31.73	-960.37	-1,865.42	252.74	-2,604.79	-463.76	910.87	-2,157.68
2	Exterior & high performance—waterborne	-0.92	-13.60	-276.45	148.42	-142.54	-161.17	1.82	-301.90
3	Interior solventborne	-13.89	-165.22	-6,584.09	48.77	-6,714.43	-93.62	128.44	-6,679.62
4	Interior waterborne	-11.15	-4.35	-64.01	107.77	28.26	-107.81	1.74	-77.81
5	Solventborne primers and undercoaters	-138.79	-923.23	-1,582.38	454.72	-2,189.67	-726.69	913.45	-2,002.91
6	Waterborne primers and undercoaters	0	-6.96	-17.74	116.42	91.72	-116.66	4.51	-20.43
7	Solventborne clear coating, sealers, stains	-79.38	-500.31	-2,142.77	230.17	-2,492.30	-396.04	481.06	-2,407.28
8	Waterborne clear coatings and stains	0	-16.76	0	43.36	26.60	-43.38	1.85	-14.93
9	Architectural lacquers	0	0	-416.23	0	-416.23	0	0	-416.23
10	Wood preservatives	0	-10.67	-288.86	4.28	-295.25	-6.89	9.47	-292.67
11	Traffic marking paints	-33.16	0	-1,475.26	47.91	-1,460.51	-120.82	0	-1,581.33
12	Special purpose	-6.44	-166.63	-159.66	107.94	-224.79	-119.53	140.84	-203.47
13	Industrial maintenance	-268.98	-1,386.52	-5,571.14	1,600.84	-5,625.80	-1,907.30	1,370.29	-6,162.80
	Total	-584.44	-4,154.61	-20,444.01[a]	3,163.33	-22,019.73	-4,263.66	3,964.32	-22,319.06

[a] Actual reformulation cost is $19.0 million, but $0.8 million is recovered by producers through price increases.

distributions (e.g., back to architectural producers) are zero.

As a point of comparison, market results were estimated subject to the lower-bound cost assumption for reformulation ($6,090/product/year). The total welfare cost under that scenario is $13.2 million per year. Because of the low reformulation cost, few products would opt for the fee under that cost scenario.

3.2 ARCHITECTURAL COATINGS INDUSTRY EMPLOYMENT IMPACTS

Regulation-induced reductions in industry output may lead to corresponding reductions in architectural coatings employment. Employment impacts are estimated by multiplying the baseline industry employment level (L_0) by the proportional change in industry output from its baseline level:

$$)L = ()Q/Q_0) \bullet L_0. \qquad (3.10)$$

This assumes a fixed relationship between output and employment, at least for the marginal changes considered here.

Table 3-3 presents the employment impacts results. Total employment for SIC 2581 is 51,100 employees.[62,63] The architectural coatings sector is a subset of SIC 2581, so the architectural coatings employment was computed by taking the ratio of architectural coatings output to SIC 2581 output and multiplying it by SIC 2581 employment. This produced an estimate of approximately 26,100 employed in the architectural coatings sector.

The proportional change in architectural coatings output was computed by taking the ratio of the change in output from the market model (summed across all market segments) over

TABLE 3-3. ESTIMATED EMPLOYMENT EFFECTS

Architectural Coatings		
Output Change (10^3 L)	Share of Baseline Output[a] (%)	Imputed Employment Change (no. of employees)
-926	-0.039%	-10.2

[a] Baseline quantity and employment computations are as follows:

Sector	Output (10^3 gal)	Output (10^3 L)	Industry Employment
SIC 2581	1,229,800	4,654,793	51,100 from Census
Architectural model	627,723	2,375,933	26,083 imputed from output share

Sources: U.S. Department of Commerce. Current Industrial Reports: Paints and Allied Products, 1991. Washington, DC, Government Printing Office. 1992.

U.S. Department of Commerce. 1991 Annual Survey of Manufactures: Statistics for Industry Groups and Industries. Washington, DC, Government Printing Office. 1992.

baseline architectural coatings output. This computation was performed for all four scenarios of the market model.

Given that the output change estimates in the market model are relatively small, it follows that the estimated employment impacts are also small. Under the standard scenario, approximately 10 jobs are lost nationwide, a 0.04 percent reduction.

61. Ref. 58.

62. Ref. 58.

63. Ref. 58.